Claims

We claim:

1. A composition, comprising a salt complex of an aliphatic ammonium cation and an anionic ligand for a mammalian cellular receptor.

2. The composition of claim 1, wherein the anionic ligand is a ligand for the allosteric site of hemoglobin.

3. The composition of claim 2, wherein the anionic ligand is a phosphorylated inositol or a phosphorylated glyceric acid.

4. The composition of claim 3, wherein the anionic ligand is inositol hexaphosphate or 2,3-DPG.

5. The composition of claim 3, wherein the anionic ligand is inositol hexaphosphate.

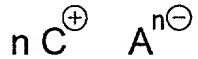
6. The composition of claim 1, wherein the aliphatic ammonium cation is a lipophilic, water-soluble aliphatic ammonium cation.

7. The composition of claim 6, wherein the aliphatic ammonium cation is a monoalkyl, dialkyl, trialkyl or tetraalkyl ammonium moiety.

8. The composition of claim 7, wherein the aliphatic ammonium cation is a monoalkyl ammonium cation.

9. The composition of claim 2, wherein the aliphatic ammonium cation is a primary ammonium cation.

10. A compound represented by generalized structure **1**:



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wherein

C^+ represents independently for each occurrence an aliphatic ammonium cation, an alkali metal cation, or an alkaline earth cation; provided that at least one instance of C^+

represents an aliphatic ammonium cation;

A^{n-} represents an anionic ligand for a mammalian cellular receptor; and

n is an integer in the range 1 to 12 inclusive.

11. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of C_1-C_6 alkyl ammonium ions and C_3-C_6 cycloalkyl ammonium ions.

12. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of C_3-C_6 cycloalkyl ammonium ions.

13. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of cyclohexyl ammonium ions.

14. The compound of claim 10, wherein A^{n-} is a ligand for the allosteric site of hemoglobin.

15. The compound of claim 10, wherein A^{n-} is a phosphorylated inositol or a phosphorylated glyceric acid.

16. The compound of claim 10, wherein A^{n-} is a phosphorylated inositol or a phosphorylated glyceric acid, wherein said phosphorylated inositol or phosphorylated glyceric acid is a ligand for the allosteric site of hemoglobin.

17. The compound of claim 10, wherein A^{n-} is IHP or 2,3-DPG.

18. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of C_1-C_6 alkyl ammonium ions and C_3-C_6 cycloalkyl ammonium ions; and A^{n-} is a ligand for the allosteric site of hemoglobin.

19. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of C_1-C_6 alkyl ammonium ions and C_3-C_6 cycloalkyl ammonium ions; and A^{n-} is a phosphorylated inositol or a phosphorylated glyceric acid.

20. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of C_1-C_6 alkyl ammonium ions and C_3-C_6 cycloalkyl ammonium ions; and A^{n-} is a phosphorylated inositol or a phosphorylated glyceric acid, wherein said phosphorylated inositol or phosphorylated glyceric acid is a ligand for the allosteric site of hemoglobin.

21. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of C_1-C_6 alkyl ammonium ions and C_3-C_6 cycloalkyl ammonium ions; and A^{n-} is IHP or 2,3-DPG.

22. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of C_3-C_6 cycloalkyl ammonium ions; and A^{n-} is a ligand for the allosteric site of hemoglobin.

23. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of C_3-C_6 cycloalkyl ammonium ions; and A^{n-} is a phosphorylated inositol or a phosphorylated glyceric acid.

24. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of C_3-C_6 cycloalkyl ammonium ions; and A^{n-} is a phosphorylated inositol or a phosphorylated glyceric acid, wherein said phosphorylated inositol or phosphorylated glyceric acid is a ligand for the allosteric site of hemoglobin.

25. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of C_3-C_6 cycloalkyl ammonium ions; and A^{n-} is IHP or 2,3-DPG.

26. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of cyclohexyl ammonium ions; and A^{n-} is a ligand for the allosteric site of hemoglobin.

27. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of cyclohexyl

ammonium ions; and A^{n-} is a phosphorylated inositol or a phosphorylated glyceric acid.

28. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of cyclohexyl ammonium ions; and A^{n-} is a phosphorylated inositol or a phosphorylated glyceric acid, wherein said phosphorylated inositol or phosphorylated glyceric acid is a ligand for the allosteric site of hemoglobin.

29. The compound of claim 10, wherein an instance of C^+ that represents an ammonium ion is selected independently for each occurrence from the group consisting of cyclohexyl ammonium ions; and A^{n-} is IHP or 2,3-DPG.

30. A method of enhancing oxygen delivery to a tissue or organ of a mammal, comprising the step of administering to said mammal, red blood cells or whole blood previously treated with a composition of claim 2 or a compound of claim 10 and subsequently suitably purified such that when said red blood cells or whole blood is administered to said mammal it is nontoxic.

31. A method of treating a mammal afflicted with anemia, coronary infarction, pulmonary disease, congestive heart failure, diabetes, myocardial infarction, stroke, peripheral vascular disease, intermittent claudication, circulatory shock, hemorrhagic shock, chronic hypoxia, altitude sickness, arteriosclerosis, respiratory alkalemia, metabolic alkalosis, sickle cell anemia, reduced lung capacity, gangrene, anaerobic infections, carbon monoxide poisoning, nitric oxide poisoning, or cyanide poisoning, comprising the step of administering to said mammal red blood cells or whole blood previously treated with a composition of claim 2 or a compound of claim 10 and subsequently suitably purified such that when said red blood cells or whole blood is administered to said mammal it is nontoxic.

32. A method of improving the oxygen delivering capability of mammalian blood, comprising the step of adding to said mammalian blood a composition of claim 2 or a compound of claim 10.

33. A method of incorporating a therapeutically useful substance into mammalian red blood cells, comprising the step of treating said mammalian red blood cells with a composition

of claim 1 or a compound of claim 10, wherein said composition or compound comprises said therapeutically useful substance.